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Functional Requirements Specification Bunching cavity for PXIE MEBT

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Revision History

Revision	Date	Section No.	Revision Description
1.0	03/05/2012	All	Initial Draft
1.1	03/08/2012	All	Draft
1.2	03/13/2012	All	Draft
1.3	05/31/2012	All	Draft
1.4	06/14/2012	All	Draft
1.5	06/21/2012	All	Draft
1.6	07/16/2012	All	Draft



Introduction and scope

Project X is a high intensity proton facility conceived to support a world-leading physics program at Fermilab [1]. The Project X Injector Experiment (PXIE) will be an integrated systems test [2] that will validate the concept for the Project X front end.

The Medium Energy (2.1 MeV, $\beta = 0.067$) Beam Transport (MEBT) section [3] includes three Bunching cavities operating at 162.5 MHz. This document specifies design cavity parameters that are essential for the beam dynamics, cavity performance, and cavities integration into MEBT.

Functional Requirements

The cavities and couplers will be designed to operate with a maximum forward power under any reflection condition.

The tuners have to be capable of supporting reliable cavity operation with 10 mA beam.

General		
	Minimum beam aperture (ID), mm	30
	Overall module length; flange-to-flange, m	≤ 0.35
	Positioning accuracy relative to the projected beam trajectory: X, Y, Z, RMS, mm Pitch and Yaw, RMS, mrad	0.5 3
	Nominal cavity operational vacuum with beam, Torr	$3e-8$
Cavity		
	Frequency, MHz	162.5
	Operating mode	CW
	Operating temperature, °C	35
	Nominal accelerating voltage at $\beta=0.067$, MV	0.07
	Maximum accelerating voltage at $\beta=0.067$, MV	0.10
	Power loss at maximum voltage, kW	≤ 3
	Frequency tuning range, kHz	100
	Maximum water supply pressure, Bar	20
Coupler		
	Coupler Power Rating (full reflection), kW	4
	Coupling coefficient	1.0
	Coupler feeder – standard coaxial with impedance, Ohm	50

**Instrumentation**

Each cavity must have a provision for use of the next instrumentation:

- Cavity field probe.
- RF coupler e-probe.
- Cavity vacuum monitor

Engineering and Safety Standards

All vacuum vessels, pressure vessels, and piping systems will be designed, documented, and tested in accordance with the appropriate Fermilab ES&H Manual (FESHM) chapters. Bellows shall be designed using the requirements of the Expansion Joint Manufacturers Association (EJMA).

Quality assurance

A Bunching cavity traveler is to be developed documenting all stages of inspection and test.

References

Documents with reference numbers listed are in the Project X DocDB:

<http://projectx-docdb.fnal.gov>

[1] Project X Functional Requirements Specification

Document #: Project-X-doc-658

[2] Project X Injector Experiment Functional Requirements Specification

Document #: Project-X-doc- 980

[3] PXIE MEBT Functional Requirements Specification

Document #: Project-X-doc-938